

27. DATA REPORT: UPPER CENOZOIC DINOFAGELLATE CYSTS FROM THE CONTINENTAL SLOPE AND RISE OFF NEW JERSEY¹

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INTRODUCTION

This report contains the occurrence data for dinoflagellate cysts recorded from 163 samples taken from Sites 902 through 906, during Ocean Drilling Program (ODP) Leg 150. The dinoflagellate cyst (dinocyst) stratigraphy has been presented in Mountain, Miller, Blum, et al. (1994), and was based on these data. This report provides the full dinocyst data set supporting the dinocyst stratigraphic interpretations made in Mountain, Miller, Blum, et al. (1994). For Miocene shipboard dinocyst stratigraphy, I delineated 10 informal zones: pre-A, and A through I, in ascending stratigraphic order. These zones are defined in Shipboard Scientific Party (1994a), and are based on my studies of Miocene dinocyst stratigraphy in the Maryland and Virginia coastal plain (de Verteuil and Norris, 1991, 1992; de Verteuil, 1995). This zonation has been slightly revised (de Verteuil and Norris, in press, a), and the new formal zone definitions are repeated below. Each new zone has an alpha-numeric abbreviation starting with "DN" (for Dinoflagellate Neogene). The equivalence between the informal zones reported in Mountain, Miller, Blum, et al. (1994), and the new DN zones is illustrated in Figure 1. For clarity, I delineated both zonations in the range charts that accompany this report (Tables 1–6). De Verteuil and Norris (in press, a), using these and other data, correlated the DN zonation with the geological time scale of Berggren et al. (1995). Figure 2 summarizes these correlations and can be used to check the chronostratigraphic position of samples in this report, as determined by dinocyst stratigraphy. A thorough discussion of the basis for, and levels of uncertainty associated with, these correlations to the Cenozoic time scale can be found in de Verteuil and Norris (in press, a).

The Appendix lists all the dinocyst taxa recorded during shipboard analyses of Leg 150 samples. Open nomenclature is used for undescribed taxa. The range charts and Appendix also include reference to several new taxa that de Verteuil and Norris (in press, b) described from Miocene coastal plain strata in Maryland and Virginia. Names of these taxa in Tables 1 through 6 and in the Appendix of this report are not intended for effective publication as defined in the International Code of Botanical Nomenclature (ICBN, Greuter et al., 1994). Therefore, taxonomic nomenclature contained in this report is not to be treated as meeting the conditions of effective and valid publication (ICBN; Article 29).

Miocene Dinocyst Zonation

(DN1) *Chiropteridium galea* Interval Zone: Interval from the highest occurrence (HO) of *Distatodinium bifffii* Brinkhuis et al. 1992 to the HO of *Chiropteridium galea* (Maier) Sarjeant 1983. Upper upper Oligocene to lower lower Miocene.

(DN2) *Sumatrardinium soucouyantiae* Interval Zone: Interval from the HO of *Chiropteridium galea* (Maier) Sarjeant 1983 to the

MIOCENE	upper	I	DN10	<i>Selenopemphix armageddonensis</i> Interval Zone
		H	DN9	<i>Hystrichosphaeropsis obscura</i> Interval Zone
		G	DN8	<i>Palaeocystodinium golzowense</i> Interval Zone
		F	DN7	<i>Cannospaeropsis passio</i> Range Zone
		E	DN6	<i>Selenopemphix dionaeacysta</i> Interval Zone
		D	DN5	<i>Batiacasphaera sphaerica</i> Interval Zone
		C	DN4	<i>Distatodinium paradoxum</i> Interval Zone
		B	DN3	<i>Cousteaudinium aubryae</i> Interval Zone
		A	DN2	<i>Sumatrardinium soucouyantiae</i> Interval Zone
		Pre A	DN1	<i>Chiropteridium galea</i> Interval Zone
OLIGOCENE				

Figure 1. Schematic comparison of the informal dinocyst zones reported in the Leg 150 *Initial Reports*, and the formalized dinocyst zonation of de Verteuil and Norris (in press, a). There is one-to-one equivalence between Zones C through I and Zones DN4 through DN10, because each pair of zones in the two zonations has the same definition. Zones pre-A through B and Zones DN1 through DN3 differ as discussed in the text and as illustrated.

HO of *Exochosphaeridium insigne* de Verteuil and Norris in press, b. Lower lower Miocene to middle lower Miocene.

(DN3) *Cousteaudinium aubryae* Interval Zone: Interval from the HO of *Exochosphaeridium insigne* de Verteuil and Norris in press, b, to the lowest occurrence (LO) of *Labyrinthodinium truncatum* Piasecki 1980. Middle lower Miocene to upper lower Miocene.

(DN4) *Distatodinium paradoxum* Interval Zone: Interval from the LO of *Labyrinthodinium truncatum* Piasecki 1980 to the HO of *Distatodinium paradoxum* (Brosius) Eaton 1976. Upper lower Miocene to lower middle Miocene.

(DN5) *Batiacasphaera sphaerica* Interval Zone: Interval from the HO of *Distatodinium paradoxum* (Brosius) Eaton 1976 to the HO of *Systematophora placacantha* (Deflandre and Cookson) Davey et al. 1969. Lower middle Miocene to middle middle Miocene.

(DN6) *Selenopemphix dionaeacysta* Interval Zone: Interval from the HO of *Systematophora placacantha* (Deflandre and Cookson) Davey et al. 1969 to the LO of *Cannospaeropsis passio* de Verteuil and Norris in press, b.

(DN7) *Cannospaeropsis passio* Range Zone: Interval between the LO and the HO of *Cannospaeropsis passio* de Verteuil and Norris in press, b. Middle middle Miocene to upper middle Miocene.

(DN8) *Palaeocystodinium golzowense* Interval Zone: Interval between the HO of *Cannospaeropsis passio* de Verteuil and Norris in press, b, to the HO of *Sumatrardinium soucouyantiae* de Verteuil and Norris 1992. Lower upper Miocene to middle upper Miocene.

(DN9) *Hystrichosphaeropsis obscura* Interval Zone: Interval from the HO of *Sumatrardinium soucouyantiae* de Verteuil and Norris

¹Mountain, G.S., Miller, K.G., Blum, P., Poag, C.W., and Twichell, D.C. (Eds.), 1996. *Proc. ODP, Sci. Results*, 150: College Station, TX (Ocean Drilling Program).

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Table 1. Stratigraphic distribution of dinocyst taxa from Holes 902A, 902C, and 902D, in ascending highest occurrence.

Table 1 (continued).

Notes: The shaded rows serve to separate samples from the three holes. The depth (mbsf) for each sample is given in Shipboard Scientific Party (1994b, table 6). Solid dots indicate in situ occurrences. There may be some stratigraphic overlap between Samples 150-902C-16H-CC and 150-902D-14H-CC. Taxon names followed by an asterisk (*) are from de Verteuil and Norris (in press, b, c); published taxon names followed by a question mark (?) indicate that assignment to the taxon is tentative.

Table 2. Stratigraphic distribution of dinocyst taxa from Hole 903A, in ascending highest occurrence.

M i o c e n e			Pleist.	
middle		upper	H?	H?
F	G	H	DN9	DN9?
DN7	DN8	DN9	150-903A-37X-CC 150-903A-39X-CC 150-903A-40X-CC 150-903A-41X-CC 150-903A-43X-CC 150-903A-45X-CC 150-903A-47X-CC 150-903A-49X-CC 150-903A-50X-CC 150-903A-51X-CC 150-903A-60X-CC 150-903A-65X-CC 150-903A-67X-CC 150-903A-68X-CC 150-903A-70X-CC 150-903A-71X-CC 150-903A-74X-CC 150-903A-76X-CC	150-903A-37X-CC 150-903A-39X-CC 150-903A-40X-CC 150-903A-41X-CC 150-903A-43X-CC 150-903A-45X-CC 150-903A-47X-CC 150-903A-49X-CC 150-903A-50X-CC 150-903A-51X-CC 150-903A-60X-CC 150-903A-65X-CC 150-903A-67X-CC 150-903A-68X-CC 150-903A-70X-CC 150-903A-71X-CC 150-903A-74X-CC 150-903A-76X-CC
Shipboard dinocyst zones (Shipboard scientific party, 1994)				
Dinoflagellate cyst zones (de Verteuil and Norris, in press, a)				
Sample nos.				
<i>Algidasphaeridium? euaxum</i> <i>Sumatrardinum druggii</i> <i>Cordosphaeridium? minimum sensu B&S 1981</i> <i>Algidasphaeridium? sp. 8</i> <i>Cannosphaeropsis passio*</i> <i>Opercudinium cf. israelianum (small)</i> <i>Artemisiocysta sp. 1</i> <i>Lejeuneocysta mariae</i> <i>Lejeuneocysta paratenella</i> <i>Geonetta clinea*</i> <i>Impagidinium pallidum</i> <i>Selenopemphix quanta</i> <i>Lejeuneocysta? sp (lateral horns)</i> <i>Algidasphaeridium? sp. 9</i> <i>Polysphaeridium zoharyi</i> <i>Algidasphaeridium? sp. 11</i> <i>Palaeocystodinium golzowense</i> <i>Sumatrardinum hispidum</i> <i>Erymnodinium delectabile</i> <i>Dapsilidinium pseudocolligerum</i> <i>Brigantedinium spp.</i> <i>Sumatrardinum soucouyantiae</i> <i>Selenopemphix brevispinosa conspicua</i> <i>Opercudinium sp. of Piasecki 1980</i> <i>Opercudinium crassum</i> <i>Algidasphaeridium? sp. 6</i> <i>Hystrichokolpoma rigaudiae</i> <i>Tuberculodinium vancampoae</i> <i>Batiacasphaera sp. cf. B. hirsuta</i> <i>Brigantedinium cariacoense</i> <i>Polykrikos kofoidii?</i> <i>Trinovantedinium? sp. 2</i> <i>Impagidinium arachnion*</i> <i>Nematosphaeropsis lemniscata</i> <i>Nematosphaeropsis rigida</i> <i>Cerebrocysta poulsenii*</i> <i>Impagidinium paradoxum</i> <i>Quinquecuspis concreta</i> <i>Lejeuneocysta convexa</i> <i>Selenopemphix dionaeacysta</i> <i>Trinovantedinium? xylochoporum</i> <i>Lejeuneocysta sp. 7</i> <i>Quadrina? condita</i> <i>Cristadinium sp. 4</i> <i>Brigantedinium? sp. 5</i> <i>Algidasphaeridium? sp. 4</i> <i>Opercudinium? eirikianum</i> <i>Invertocysta lacrymosa</i> <i>Lingulodinium machaerophorum</i> <i>Lejeuneocysta catoma</i> <i>Xandarodinium xanthum sensu Head et al. 1989a</i> <i>Lejeuneocysta sp. 3</i> <i>Hystrichosphaeropsis obscura</i> <i>Achromosphaera andalousiensis</i> <i>Habibacysta tectata</i> <i>Filisphaera microornata</i> <i>Selenopemphix brevispinosa brevispinosa</i> <i>Trinovantedinium harpagonium</i> <i>Trinovantedinium ferugnomatum</i> <i>Trinovantedinium glorianum</i> <i>Lejeuneocysta sp. 8</i>				
Sample nos.				

Table 2 (continued).

M i o c e n e				Shipboard dinocyst zones (Shipboard scientific party, 1994)	
middle	upper	Pleist.	Hol.	DN9?	DN9?
F	G		H	DN9	DN9
DN7	DN8				
150-903A-37X-CC					
150-903A-39X-CC					
150-903A-40X-CC					
150-903A-43X-CC					
150-903A-49X-CC					
150-903A-50X-CC					
150-903A-51X-CC					
150-903A-60X-CC					
150-903A-67X-CC					
150-903A-68X-CC					
150-903A-70X-CC					
150-903A-71X-CC					
150-903A-74X-CC					
150-903A-76X-CC					
150-903A-77X-CC					
150-903A-79X-CC					
150-903A-80X-CC					
150-903A-81X-CC					
150-903A-82X-CC					
150-903A-83X-CC					
150-903A-84X-CC					
150-903A-85X-CC					
150-903A-87X-CC					
150-903A-89X-CC					
150-903A-90X-CC					
150-903A-91X-CC					
150-903A-92X-CC					
150-903A-93X-CC					
150-903A-94X-CC					
150-903A-95X-CC					
150-903A-96X-CC					
150-903A-97X-CC					
150-903A-98X-CC					
150-903A-99X-CC					
150-903A-100X-CC					
150-903A-60X-CC					
150-903A-65X-CC					
150-903A-68X-CC					
150-903A-69X-CC					
150-903A-70X-CC					
150-903A-71X-CC					
150-903A-74X-CC					
150-903A-76X-CC					

Notes: The depth (mbsf) for each sample is given in Shipboard Scientific Party (1994c, table 4). Solid dots indicate in situ occurrences; the symbol "R" indicates occurrences that are considered to have resulted from reworking. Taxon names followed by an asterisk (*) are from de Verteuil and Norris (in press, b, c); published taxon names followed by a question mark (?) indicate that assignment to the taxon is tentative.

1992 to the HO of *Hystrichosphaeropsis obscura* Habib 1972. Middle upper Miocene to upper upper Miocene.

(DN10) *Selenopemphix armageddonensis* Interval Zone: Interval from the HO of *Hystrichosphaeropsis obscura* Habib 1972 to the HO of *Erymnodinium delectabile* (de Verteuil and Norris) Lentin et al. 1994. Upper upper Miocene.

Zonation Changes

Comparing the definitions of the informal dinocyst zones (Shipboard Scientific Party, 1994a) with those given above shows that the informal Zones C through I are precisely equivalent to the new formal Zones DN4 through DN10 (Fig. 1). (The informal taxon *Cannosphaeropsis* sp. cf. *C. utinensis* refers to the species *Cannosphaeropsis passio* de Verteuil and Norris in press, b). The only changes occur between the lower Miocene zones pre-A, A, B and DN1, DN2, DN3.

Informal dinocyst Zone pre-A was defined as the interval from the HO of *Saturnodinium* (*al Thalassiphora?*) *pansum* (Stover) Brinkhuis et al. 1992, to the HO of *Chiropteridium* spp. (Shipboard Scientific Party, 1994a). In the lower Miocene of the New Jersey continental margin, the HO of *Chiropteridium* spp. and the HO of *Chiropteridium galea* are the same biostratigraphic event. This is based on acceptance of the taxonomic synonymies listed for *C. galea* in Lentin and Williams (1993). The HO of *S. pansum* near the middle of calcareous nannofossil Zone NP25, however, is below the HO of *Dis-*

tatodinium bifii, which is in the upper part of Zone NP25 (Brinkhuis et al., 1992). Thus, the lower boundary of Zone pre-A is below that of Zone DN1, but the upper boundaries of both zones are the same (Fig. 1).

(Fig. 1). The upper boundaries of Zone B and Zone DN3 are both defined on the LO of *Labyrinthodinium truncatum* Piasecki 1980, so that together, Zones A and B and Zones DN2 and DN3, both span the same chronostratigraphic interval (Fig. 1). The HO of *Cordosphaeridium cantharellum* (Brosius) Gocht 1969, which defines the boundary between Zones A and B, is below the HO of *Exochosphaeridium insigne* de Verteuil and Norris (in press, b), which defines the boundary between Zones DN2 and LN3 (Fig. 1).

CONCLUSIONS

The range data for Neogene dinoflagellate cysts presented in Tables 1 through 6 demonstrate the utility of this group for stratigraphic subdivision in the western North Atlantic. Integration of these data with results from sedimentological, isotopic, paleontological and geophysical studies, in a sequence stratigraphic framework, is underway. The distribution of dinocyst taxa in Leg 150 sites is consistent with that observed by de Verteuil and Norris (in press, a) for the adjacent Atlantic coastal plain. For many taxa, such as those included in Figure 2, these ranges appear to approximately reflect the known

Table 3. Stratigraphic distribution of dinocyst taxa from Hole 903C, in ascending highest occurrence.

Table 3 (continued).

	Sample nos.
	150-903C-9R(CC)
	150-903C-10R, 5, 83-88
	150-903C-10R(CC)
	150-903C-11R(CC)
	150-903C-15R(CC)
	150-903C-20R(CC)
	150-903C-21R(CC)
	150-903C-22R(CC)
	150-903C-23R(CC)
	150-903C-24R(CC)
	150-903C-25R(CC)
	150-903C-31R(CC)
	150-903C-26R(CC)
	150-903C-28R(CC)
	150-903C-32R(CC)
	150-903C-33R(CC)
	150-903C-34R(CC)
	150-903C-35R(CC)
	150-903C-36R(CC)
	150-903C-38R(CC)
	150-903C-39R(CC)
	150-903C-40R(CC)
	150-903C-43R(CC)
	150-903C-45R(CC)
	150-903C-48R(CC)
<i>Impagidinium pallidum</i>	
<i>Sumatradinium hispidum</i>	
<i>Spiniferites pseudofurcatus</i>	
<i>Batiacasphaera sphaerica</i>	
<i>Operculodinium cf. israelianum (small)</i>	
<i>Cannosphaeropsis passionis*</i>	
<i>Batiacasphaera sp. cf. B. hirsuta</i>	
<i>Cristadinium diminutivum</i>	
<i>Selenopemphix brevispinosa conspicua</i>	
<i>Quadrina? condita</i>	
<i>Nematosphaeropsis lemniscata</i>	
<i>Tectatodinium pellitum</i>	
<i>Artemisiocysta sp. 1</i>	
<i>Trinovantedinium ferugnomatum</i>	
<i>Sumatradinium druggii</i>	
<i>Algidasphaeridium? sp. 5</i>	
<i>Algidasphaeridium? sp. 8</i>	
<i>Hystrichosphaeropsis obscura</i>	
<i>Cordosphaeridium? minimum sensu B&S 1981</i>	
<i>Polysphaeridium zoharyi</i>	
<i>Geonetta clineae*</i>	
<i>Palaeocystodinium golzowense</i>	
<i>Operculodinium centrocarpum s.s.</i>	
<i>Selenopemphix sp. cf. S. nephroides</i>	
<i>Lejeunecysta convexa</i>	
<i>Selenopemphix dionaeacysta</i>	
<i>Cristadinium cristatoserratum</i>	
<i>Selenopemphix brevispinosa brevispinosa</i>	
<i>Trinovantedinium? xylochoporum</i>	
<i>Trinovantedinium harpagonium</i>	
<i>Lejeunecysta sp. 8</i>	
<i>Lejeunecysta? sp (lateral horns)</i>	
<i>Sumatradinium soucouyaniae</i>	
<i>Brigantedinium? sp. 5</i>	
<i>Brigantedinium? sp. 6</i>	
<i>Operculodinium sp. 3</i>	
<i>Dapsilidinium pseudocolligerum</i>	
<i>Reticulatosphaera actinocoronata</i>	
<i>Algidasphaeridium? sp. 11</i>	
<i>Labyrinthodinium truncatum truncatum</i>	
<i>Tuberculodinium vancampoae</i>	
<i>Lingulodinium machaerophorum</i>	
<i>Habibacysta tectata</i>	
<i>Brigantedinium spp.</i>	
<i>Xandarodinium xanthum sensu Head et al. 1989a</i>	
<i>Spiniferites spp.</i>	
<i>Algidasphaeridium? euaxum</i>	
<i>Polykrikos kofoidii?</i>	

150-903C
98 species encountered in 27 samples

Notes: The depth (mbsf) for each sample is given in Shipboard Scientific Party (1994c, table 4). Solid dots indicate in situ occurrences; the symbol "R" indicates occurrences that are considered to have resulted from reworking. Taxon names followed by an asterisk (*) are from de Verteuil and Norris (in press, b, c); published taxon names followed by a question mark (?) indicate that assignment to the taxon is tentative.

Table 4. Stratigraphic distribution of dinocyst taxa from Hole 904A, in ascending highest occurrence.

Miocene			
lw.	middle	upp.	
A	F	G	Shipboard dinocyst zones (Shipboard scientific party, 1994)
	DN8	DN8	Dinoflagellate cyst zones (de Verteuil and Norris, in press, a)
	DN7	DN7	Sample nos.
	DN4	DN4	
	DN2	DN2	
●	150-909A-12H-CC	150-909A-12H-CC	<i>Cyclopsiella elliptica/granosa complex</i>
●	150-909A-13H-CC	150-909A-13H-CC	<i>Apteodinium spiridooides</i>
●	150-909A-14H-CC	150-909A-14H-CC	<i>Operculodinium placitum</i>
●	150-909A-15H-CC	150-909A-15H-CC	<i>Cordosphaeridium cantharellus</i>
●	150-909A-21H-CC	150-909A-21H-CC	<i>Hystricholopoma truncata</i>
●	150-909A-22H-CC	150-909A-22H-CC	<i>Lingulodinium multivirgatum*</i>
●	150-909A-23H-CC	150-909A-23H-CC	<i>Trinovantedinium ferugnomatum</i>
●	150-909A-30H-CC	150-909A-30H-CC	<i>Lejeuneacysta sp. 7</i>
●	150-909A-31H-CC	150-909A-31H-CC	<i>Spiniferites ramosus complex</i>
●			<i>Cribroperidinium tenuitabulatum</i>
●			<i>Operculodinium cf. israelianum (small)</i>
●			<i>Melitasphaeridium choanophorum</i>
●			<i>Systematophora placacantha</i>
●			<i>Cousteaudinium Aubryae*</i>
●			<i>Distatodinium paradoxum</i>
●			<i>Labyrinthodinium truncatum modicum*</i>
●			<i>Spiniferites membranous</i>
●			<i>Tectatodinium sp. 3 of Manum et al. 1989</i>
●			<i>Trinovantedinium sp. of LeNoir 1986</i>
●			<i>Apteodinium rectatum</i>
●			<i>Pentadinium laticinctum</i>
●			<i>Tectatodinium simplex sensu Edwards '84</i>
●			<i>Lejeuneacysta sp. 10</i>
●			<i>Algidasphaeridium? sp. 4</i>
●			<i>Algidasphaeridium? sp. 10</i>
●			<i>Quadrina? condita</i>
●			<i>Trinovantedinium? xylochoporum</i>
●			<i>Lejeuneacysta paratenella</i>
●			<i>Nematosphaeropsis rigida</i>
●			<i>Cordosphaeridium? minimum sensu B&S 1981</i>
●			<i>Polysphaeridium zoharyi</i>
●			<i>Hystricholopoma rigaudiae</i>
●			<i>Selenopemphix sp. cf. S. nephroides</i>
●			<i>Algidasphaeridium? sp. 8</i>
●			<i>Cannosphaeropsis passio*</i>
●			<i>Algidasphaeridium? sp. 11</i>
●			<i>Labyrinthodinium truncatum truncatum</i>
●			<i>Polykrikos schwartzii?</i>
●			<i>Selenopemphix quanta</i>
●			<i>Ascostomocystis? sp.</i>
●			<i>Nematosphaeropsis lativittatus</i>
●			<i>Operculodinium janduchenei</i>
●			<i>Batiacasphaera sp. cf. B. hirsuta</i>
●			<i>Spiniferites spp.</i>
●			<i>Lejeuneacysta sp. 3</i>
●			<i>Trinovantedinium harpagonium</i>
●			<i>Sumatrardinum druggii</i>
●			<i>Brigantedinium? sp. 5</i>
●			<i>Brigantedinium? sp. 6</i>
●			<i>Impagidinium patulum</i>
●			<i>Heteraulacacysta campanula</i>
●			<i>Operculodinium centrocarpum s.s.</i>
●			<i>Impagidinium paradoxum</i>
●			<i>Algidasphaeridium? euaxum</i>
●			<i>Lejeuneacysta convexa</i>
●			<i>Selenopemphix dionaea cysta</i>
●			<i>Selenopemphix brevispinosa brevispinosa</i>
●			<i>Lejeuneacysta sp. 8</i>
●			<i>Sumatrardinum soucouyaniae</i>
●			<i>Hystrichosphaeropsis obscura</i>

Table 4 (continued).

		<i>Spiniferites pseudofurcatus</i>
		<i>Operculodinium sp. 3</i>
		<i>Dapsilidinium pseudocollegerum</i>
		<i>Reticulatospaera actinocoronata</i>
		<i>Tuberculodinium vancampoaee</i>
		<i>Lingulodinium machaerophorum</i>
		<i>Palaeocystodinium golzowense</i>
		<i>Batiacasphaera sphaerica</i>
		<i>Habibacysta tectata</i>
		<i>Tectatodinium pellitum</i>
		<i>Impagidinium sp. 3 sensu Manum et al. 1989</i>
		<i>Brigantedinium spp.</i>
		<i>Artemisiocysta sp. 1</i>
		<i>Polykrikos kofoidi?</i>
		<i>Quinquecuspis concreta</i>
		Sample nos.
	150-904A-1-2H-CC- 150-904A-1-3H-CC- 150-904A-1-4H-CC- 150-904A-17H-CC- 150-904A-21H-CC- 150-904A-22H-CC- 150-904A-23H-CC- 150-904A-28H-CC- 150-904A-30H-CC- 150-904A-31X-CC-	

Notes: The depth (mbsf) for each sample is given in Shipboard Scientific Party (1994d, table 5). Solid dots indicate in situ occurrences. Taxon names followed by an asterisk (*) are from de Verteuil and Norris (in press. b, c); published taxon names followed by a question mark (?) indicate that assignment to the taxon is tentative.

maximum stratigraphic ranges globally. For others, including many of the protoperidinioid species, far less is known regarding their distribution in time and space.

The prevalence of open nomenclature in the taxon list (Appendix) indicates the substantial number of undescribed species present in these Neogene assemblages. This is particularly so among forms with probable protoperidinioid affinity (e.g., *Algidasphaeridium*? spp. and *Brigantedinium*? spp.).

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APPENDIX

Dinoflagellate Cyst Taxa

Following is a list of all dinoflagellate cyst taxa recovered from the upper Cenozoic sections at Sites 902 through 906, ODP Leg 150. Published species names followed by a question mark (?) indicate that assignment of material to that species is tentative. Taxonomic references not included in the bibliography are in Lentin and Williams (1993) and Head (1996).

- Achomosphaera andalousiensis* Jan du Chene 1977
Achomosphaera andalousiensis sensu Harland 1988
Achomosphaera ramulifera (Deflandre) Evitt 1963
Achomosphaera sp. cf. *A. ramulifera* of Anstey 1992
Algidasphaeridium? *euaxum* Head 1993
Algidasphaeridium? *minutum* (Harland and Reid) Matsuoka and Bujak 1988
Algidasphaeridium? sp. 1
Algidasphaeridium? sp. 2
Algidasphaeridium? sp. 3
Algidasphaeridium? sp. 4
Algidasphaeridium? sp. 5
Algidasphaeridium? sp. 6
Algidasphaeridium? sp. 7
Algidasphaeridium? sp. 8
Algidasphaeridium? sp. 9
Algidasphaeridium? sp. 10
Algidasphaeridium? sp. 11
Amicosphaera umbracula Harland 1979
Apteodinium spiridooides Benedek 1972
Apteodinium tectatum Piasecki 1980
Artemisiocysta sp. 1
Ascostomocystis sp. 1
Ascostomocystis? sp.
Barssidinium evangeliae Lentin et al. 1994
Barssidinium graminosum Lentin et al. 1994
Barssidinium sp. 3
Barssidinium sp. cf. *B. graminosum* Lentin et al. 1994
Barssidinium wrennii Lentin et al. 1994
Batiacasphaera gemmata Head et al. 1989
Batiacasphaera sphaerica Stover 1977
Batiacasphaera sp. cf. *B. hirsuta* Stover 1977
Batiacasphaera sp. cf. *B. sphaerica* (thick wall)
Bitectatodinium tepikense Wilson 1973
Bitectatodinium? sp. 1
Brigantedinium cariacense (Wall) Reid 1977
Brigantedinium simplex (Wall) Reid 1977
Brigantedinium spp.
Brigantedinium? sp. 1
Brigantedinium? sp. 2
Brigantedinium? sp. 5
Brigantedinium? sp. 6
Brigantedinium? sp. 7
Brigantedinium? sp. 8
Brigantedinium? sp. 9
Brigantedinium? sp. 10
Brigantedinium? sp. 11
Caligodinium amicum Drugg 1970
Cannospaeropsis passio de Verteuil and Norris in press b
Capillicysta fusca Matsuoka and Bujak 1987
Cerebrocysta mediterranea Biffi and Manum 1988
Cerebrocysta poulsenii de Verteuil and Norris in press b
Cerebrocysta satchelliae de Verteuil and Norris in press b
Chiropteridium galea (Maier) Sarjeant 1983
Cordosphaeridium cantharellus (Brosius) Gocht 1969
Cordosphaeridium funiculatum Morgenroth 1966
Cordosphaeridium minimum sensu Eaton 1976
Cordosphaeridium? *minimum* sensu Benedek and Sarjeant 1980
Cousteaudinium Aubryae de Verteuil and Norris in press b
Cribroperidinium tenuitubulatum (Gerlach) Helenes 1984
Cristadinium cristatoserratum Head et al. 1989
Cristadinium diminutivum Head et al. 1989
Cristadinium sp. 4
Cyclopsiella granosa Matsuoka 1983
Cyclopsiella sp. cf. *C. vieta* Drugg and Loeblich 1967
Cyclopsiella? sp. cf. *C? trematophora* (Cookson and Eisenack) Lentin and Williams 1977
Cymatiosphaera invaginata Head et al. 1989
Cyst type I of Vernal and Mudie 1989
Danea sp. of Edwards 1984
Dapsilidinium pseudocollegerum (Stover) Bujak et al. 1980
Deflandrea phosphorita Eisenack 1938
Dinopterygium cladoides sensu Morgenroth 1966
Dissodium? sp.
Distatodinium bifffii Brinkhuis, Powell and Zavenboom 1992
Distatodinium ellipticum (Cookson) Eaton 1976
Distatodinium paradoxum (Brosius) Eaton 1976
Erymnodinium delectabile (de Verteuil and Norris) Lentin et al. 1994
Evittosphaerula paratabulata Manum 1979
Exochosphaeridium insigne de Verteuil and Norris in press b
Filisphaera filifera Bujak 1984
Filisphaera microornata (Head et al.) Head 1994
Geonettia clineae de Verteuil and Norris in press c
Habibacysta tectata Head et al. 1989
Heteraulacocysta campanula Drugg and Loeblich 1967
Homotryblium vallum Stover 1977
Hystrichokolpoma cinctum Klumpp 1953
Hystrichokolpoma rigaudiae Deflandre and Cookson 1955
Hystrichokolpoma truncata Biffi and Manum 1988
Hystrichosphaeropsis obscura Habib 1972
Hystrichosphaeropsis sp. (serrate periblast)
Impagidinium aculeatum (Wall) Lentin and Williams 1981
Impagidinium arachnion de Verteuil and Norris in press b
Impagidinium fenestroseptatum Head et al. 1989
Impagidinium japonicum Matsuoka 1983
Impagidinium minor Biffi and Manum 1988
Impagidinium multiplexum Wall and Dale 1968
Impagidinium pallidum Bujak 1984
Impagidinium paradoxum (Wall) Stover and Evitt 1978
Impagidinium patulum (Wall) Stover and Evitt 1978
Impagidinium sp. 3
Impagidinium sp. 3 of Manum et al. 1989
Impagidinium sphaericum (Wall) Lentin and Williams 1981
Impagidinium velorum Bujak 1984
Incertae sedis sp. I of Edwards 1984
Invertocysta lacrymosa Edwards 1984
Labyrinthodinium truncatum sp. *modicum* de Verteuil and Norris in press b
Labyrinthodinium truncatum sp. *truncatum* Piasecki 1980
Leipokatium invisitatum Bradford 1975
Lejeunecysta catoma Harland 1991
Lejeunecysta communis Biffi and Grignani 1983
Lejeunecysta convexa Matsuoka and Bujak 1988
Lejeunecysta mariaeae Harland et al. 1991
Lejeunecysta paraenella (Benedek) Artzner and Dorhofer 1978
Lejeunecysta sp. 3
Lejeunecysta sp. 5
Lejeunecysta sp. 7
Lejeunecysta sp. 8
Lejeunecysta sp. 9
Lejeunecysta sp. 10

- Lejeuneacysta* sp. 11
Lejeuneacysta? sp. (lateral horns)
Lingulodinium machaeophorum (Deflandre and Cookson) Wall 1967
Lingulodinium multivirgatum de Verteuil and Norris in press b
Melitasphaeridium choanophorum (Deflandre and Cookson) Harland and Hill 1979
Membranophoridium aspinatum Gerlach 1961
Nematosphaeropsis lativittatus Wrenn 1988
Nematosphaeropsis lemniscata Bujak 1984
Nematosphaeropsis rigida Wrenn 1988
Operculodinium centrocarpum s.s. (Deflandre and Cookson) Wall 1967
Operculodinium centrocarpum sensu Wall and Dale 1966
Operculodinium cf. *giganteum* of Manum et al. 1989
Operculodinium crassum Harland 1979
Operculodinium israelianum s.l. (Rossignol) Wall 1976
Operculodinium sp. cf. *O. israelianum* (Rossignol) Wall 1967
Operculodinium janduchenei Head et al. 1989
Operculodinium longispinigerum Matsuoka 1983
Operculodinium placitum Drugg and Loeblich 1967
Operculodinium sp. 3 of de Verteuil and Norris in press, b
Operculodinium sp. of Piasecki 1980
Operculodinium? eirikianum Head et al. 1989
Palaeocystodinium golzowense Alberti 1961
Pentadinium laticinctum Gerlach 1961
Pentadinium sp. I of Edwards 1986
Polykrikos kofoidii? Chatton 1914
Polykrikos schwartzii? Butschli 1873
Polysphaeridium zoharyi (Rossignol) Bujak et al. 1980
Protoperidinium subinerme (Paulsen) Loeblich III 1969
Pyxidinopsis fairhavenensis de Verteuil and Norris in press b
Pyxidinopsis pastilliformis Matsuoka and Head 1992
Pyxidinopsis sp. 1 of Manum et al. 1989
Quadrina? condita de Verteuil and Norris 1992
Quinquecuspis concreta (Reid) Head 1993
Reticulatospaera actinocoronata (Benedek) Bujak and Matsuoka 1986
Riculacysta perforata Stover 1977
Saturnodinium (al *Thalassiphora?*) *pansum* (Stover) Brinkhuis et al. 1992
Saturnodinium sp. cf. *S. perforatum* Brinkhuis et al. 1992
Selenopemphix armageddonensis de Verteuil and Norris 1992
Selenopemphix brevispinosa ssp. *brevispinosa* Head et al. 1989
Selenopemphix brevispinosa ssp. *conspicua* de Verteuil and Norris 1992
Selenopemphix dionaeacysta Head et al. 1989
Selenopemphix nephroides Benedek 1972
Selenopemphix quanta (Bradford) Matsuoka 1985
Selenopemphix sp. cf. *S. armata* Bujak 1980
Selenopemphix sp. cf. *S. nephroides*
Spiniferites bentorii (Rossignol) Wall and Dale 1970
Spiniferites delicatus Reid 1974
Spiniferites elongatus Reid 1974
Spiniferites frigidus Harland 1980
Spiniferites lazus sensu Harland 1988
Spiniferites membranosus (Rossignol) Sarjeant 1970
Spiniferites mirabilis (Rossignol) Sarjeant 1970
Spiniferites pseudofurcatus (Klumpp) Sarjeant 1970
Spiniferites ramosus complex
Spiniferites solidago de Verteuil and Norris in press b
Spiniferites sp. cf. *S. rubinus* (Rossignol) Sarjeant 1970
Spiniferites spp.
Stoveracysta conerae Biffi and Manum 1988
Sumatrardinum druggii Lentin et al. 1994
Sumatrardinum hamulatum de Verteuil and Norris in press b
Sumatrardinum hispidum (Drugg) Lentin and Williams 1976
Sumatrardinum soucouyaniae de Verteuil and Norris 1992
Systematophora placacantha (Deflandre and Cookson) Davey et al. 1969
Tectatodinium pellitum Wall 1967
Tectatodinium simplex of Edwards 1984
Tectatodinium sp. 3 of Manum et al. 1989
Thalassiphora pelagica (Eisenack) Eisenack and Gocht 1960
Trinovantedinium ferugnomatum de Verteuil and Norris 1992
Trinovantedinium glorianum (Head et al.) de Verteuil and Norris 1992
Trinovantedinium harpagonium de Verteuil and Norris 1992
Trinovantedinium papulum de Verteuil and Norris 1992
Trinovantedinium sp. cf. *T. boreale* Bujak 1984
Trinovantedinium sp. of LeNoir 1986
Trinovantedinium? *xylochoporum* de Verteuil and Norris 1992
Trinovantedinium? sp. 2
Tuberculodinium vancampoae (Rossignol) Wall 1967
Unipontidinium aquaeductum (Piasecki) Wrenn 1988
Unipontidinium? sp. cf. *U. aquaeductum* (Piasecki) Wrenn 1988
Xandarodinium xanthum sensu Head et al. 1989

Table 5. Stratigraphic distribution of dinocyst taxa from Hole 905A, in ascending highest occurrence.

Table 5 (continued).

Sample nos.	Nematosphaeropsis rigida
50.905A-10H-CC	Amiculosphaera umbracula
50.905A-16X-CC	Bitectatodinium? sp. 1
50.905A-19X-CC	Filisphaera microornata
50.905A-22X-CC	Selenopemphix sp. cf. <i>S. nephroides</i>
50.905A-28X-CC	Selenopemphix brevispinosa brevispinosa
50.905A-32X-CC	Algidasphaeridium? sp. 6
50.905A-37X-CC	Algidasphaeridium? sp. 7
50.905A-43X-CC	Algidasphaeridium? minutum
50.905A-49X-CC	Operculodinium? eirikanum
50.905A-70X-CC	Reticulatosphaera actinocoronata
50.905A-89X-CC	Algidasphaeridium? sp. 11
50.905A-93X-CC	Operculodinium janduchenei
50.905A-97X-CC	Batiacasphaera sphaerica
50.905A-98X-CC	Cymatiosphaera invaginata
50.905A-102R-CC	Impagidinium paradoxum
50.905A-103R-CC	Trinovantedinium glorianum
50.905A-104R-CC	Selenopemphix armageddonensis
50.905A-105R-CC	Cyclopsiella? sp. cf. <i>C. trematophora</i>
50.905A-106R-CC	Barssidinium evangeliae
50.905A-107R-CC	Barssidinium sp. cf. <i>B. graminosum</i>
50.905A-108R-CC	Algidasphaeridium? sp. 5
50.905A-109R-CC	Impagidinium patulum
50.905A-110R-CC	Invertocysta lacrymosa
50.905A-111R-CC	Impagidinium aculeatum
50.905A-112R-CC	Algidasphaeridium? euaxum
50.905A-113R-CC	Achomosphaera ramulifera
50.905A-114R-CC	Barssidinium sp. 3
50.905A-115R-CC	Lejeunecysta communis
50.905A-116R-CC	Lejeunecysta convexa
50.905A-117R-CC	Barssidinium graminosum
50.905A-118R-CC	Brigantedinium? sp. 6
50.905A-119R-CC	Algidasphaeridium? sp. 8
50.905A-120R-CC	Systematophora placacantha
50.905A-121R-CC	Tuberculodinium vancampoeae
50.905A-122R-CC	Habibacysta tectata
50.905A-123R-CC	Chiropteridium galea
50.905A-124R-CC	Operculodinium centrocarpum s.s.
50.905A-125R-CC	Brigantedinium spp.
50.905A-126R-CC	Achomosphaera sp. cf. <i>A. ramulifera</i> of Anstey 1992
50.905A-127R-CC	Polykrikos kofoidi?
50.905A-128R-CC	Riculacysta perforata
50.905A-129R-CC	Hystrichokolpoma rigaudiae
50.905A-130R-CC	Spiniferites mirabilis
50.905A-131R-CC	Trinovantedinium sp. of LeNoir 1986
50.905A-132R-CC	Spiniferites spp.
50.905A-133R-CC	Quinquecuspis concreta
50.905A-134R-CC	Impagidinium multiplexum
50.905A-135R-CC	Selenopemphix dionaeacyasta
50.905A-136R-CC	Nematosphaeropsis lemniscata
50.905A-137R-CC	Lingulodinium machaerophorum
50.905A-138R-CC	Spiniferites delicatus?
50.905A-139R-CC	Selenopemphix nephroides
50.905A-140R-CC	Selenopemphix quanta
50.905A-141R-CC	Brigantedinium sp. 1
50.905A-142R-CC	Spiniferites bentorii
50.905A-143R-CC	Spiniferites ramosus complex
50.905A-144R-CC	Polysphaeridium zoharyi
50.905A-145R-CC	Operculodinium israelianum s.l.
50.905A-146R-CC	Melitasphaeridium choanophorum
50.905A-147R-CC	Tectatodinium pellitum
50.905A-148R-CC	Filisphaera filifera
50.905A-149R-CC	Spiniferites elongatus
50.905A-150R-CC	Bitectatodinium tepikense
50.905A-151R-CC	Spiniferites frigidus
50.905A-152R-CC	Brigantedinium simplex
50.905A-153R-CC	Brigantedinium cariacense
50.905A-154R-CC	Operculodinium centrocarpum sensu Wall & Dale 1968
50.905A-155R-CC	Achomosphaera andalouisiensis sensu Harland 1988
50.905A-156R-CC	Spiniferites membranosus
50.905A-157R-CC	Spiniferites sp. cf. <i>S. rubinus</i>
50.905A-158R-CC	Spiniferites lazus sensu Harland

Notes: The depth (mbsf) for each sample is given in Shipboard Scientific Party (1994e, table 4). Solid dots indicate in situ occurrences; the symbol "R" indicates occurrences that are considered to have resulted from reworking; the symbol "?" in the chart indicates tentative identification of the taxon in a particular sample. Taxon names followed by an asterisk (*) are from de Verteuil and Norris (in press, b, c); published taxon names followed by a question mark (?) indicate that assignment to the taxon is tentative.

Table 6. Stratigraphic distribution of dinocyst taxa from Hole 906A, in ascending highest occurrence.

		M i o c e n e			Sample nos.
		middle		upper	
Pliocene		H	DN9	150-906A-4H-CC	
				150-906A-5H-CC	Shipboard dinocyst zones (Shipboard scientific party, 1994)
			G	150-906A-7H-CC	Dinoflagellate cyst zones (de Verteuil and Norris, in press, a)
			DN8	150-906A-9X-CC	
				150-906A-11X-CC	
				150-906A-13X-CC	
				150-906A-17X-CC	<i>Cordosphaeridium cantharellus</i>
				150-906A-19X-CC	<i>Cribroperidinium tenuitabulatum</i>
				150-906A-21X-CC	<i>Dinopterygium cladooides</i> sensu Morgenroth 1966
				150-906A-23X-CC	<i>Cerebrocysta mediterranea</i>
				150-906A-25X-CC	<i>Saturnodinium pansum</i>
				150-906A-29X-CC	<i>Hystrichokolpoma truncata</i>
				150-906A-31X-CC	<i>Caligodinium amicum</i>
				150-906A-33X-CC	<i>Deflandrea phosphoritica</i>
				150-906A-37X-CC	<i>Hystrichokolpoma cinctum</i>
				150-906A-41X-CC	<i>Distatodinium ellipticum</i>
				150-906A-43X-CC	<i>Apteodinium spiridooides</i>
				150-906A-47X-CC	<i>Hystrichokolpoma rigaudiae</i>
				150-906A-49X-CC	<i>Distatodinium paradoxum</i>
			E	150-906A-51X-CC	<i>Cordosphaeridium minimum</i> sensu Eaton
			DN6	150-906A-53X-CC	<i>Chiropteridium galea</i>
				150-906A-55X-CC	<i>Membranophoridium aspinatum</i>
				150-906A-57X-CC	<i>Homotryblium vallum</i>
upper	Oligocene			●	<i>Protoperidinium subinerme</i>
					<i>Distatodinium bifffii</i>
					<i>Lingulodinium multivirgatum</i> *
					<i>Cyclopsiella elliptica/granosa complex</i>
					<i>Cerebrocysta poulsenii</i> *
					<i>Spiniferites solidago</i> *
					<i>Trinovantedinium papulum</i>
					<i>Algidasphaeridium?</i> sp. 2
					<i>Cristadinium cristatoserratum</i>
					<i>Trinovantedinium</i> sp. of LeNoir 1986
					<i>Spiniferites pseudofurcatus</i>
					<i>Operculodinium</i> sp. 3
					<i>Lejeuneacysta</i> sp. 7
					<i>Dissodium?</i> sp.
					<i>Trinovantedinium?</i> sp. 2
					<i>Brigantedinium?</i> sp. 2
					<i>Cymatiosphaera invaginata</i>
					<i>Brigantedinium cariacense</i>
					<i>Polykrikos schwartzii?</i>
					<i>Lejeuneacysta?</i> sp (lateral horns)
					<i>Lejeuneacysta</i> sp. 10
					<i>Lejeuneacysta paratenella</i>
					<i>Algidasphaeridium?</i> sp. 3
					<i>Algidasphaeridium?</i> sp. 4
					<i>Operculodinium</i> sp. of Piasecki 1980
					<i>Batiacasphaera</i> sp. cf. <i>B. hirsuta</i>
					<i>Operculodinium crassum</i>
					<i>Lejeuneacysta</i> sp. 9
					<i>Systematophora placacantha</i>
					<i>Hystrichosphaeropsis</i> sp. (<i>serrate periblast</i>)
					<i>Selenopemphix</i> sp. cf. <i>S. nephroides</i>
					<i>Cannosphaeropsis passio</i> *
					<i>Cordosphaeridium?</i> <i>minimum</i> sensu B&S 1981
					<i>Batiacasphaera</i> sp. cf. <i>B. sphaerica</i> (thick wall)
					<i>Lejeuneacysta</i> sp. 8
					<i>Sumatrardinium hispidum</i>

Table 6 (continued).

	Sample nos.	Algidasphaeridium? sp. 9
		<i>Capillicysta fusca</i>
		<i>Algidasphaeridium? sp. 8</i>
		<i>Polysphaeridium zoharyi</i>
		<i>Selenopemphix nephroides</i>
		<i>Trinovantedinium? xylochoporum</i>
		<i>Trinovantedinium harpagorum</i>
		<i>Algidasphaeridium? sp. 1</i>
		<i>Algidasphaeridium? sp. 5</i>
		<i>Dapsilidinium pseudocolligerum</i>
		<i>Habibacysta tectata</i>
		<i>Polykrikos kofoidii?</i>
		<i>Cristadinium sp. 4</i>
		<i>Sumatrardinium druggii</i>
		<i>Sumatrardinium soucouyantiae</i>
		<i>Erymnodinium delectabile</i>
		<i>Brigantedinium? sp. 5</i>
		<i>Brigantedinium? sp. 6</i>
		<i>Algidasphaeridium? sp. 6</i>
		<i>Algidasphaeridium? minutum</i>
		<i>Impagidinium arachnion*</i>
		<i>Operculodinium israelianum s.l.</i>
		<i>Algidasphaeridium? sp. 11</i>
		<i>Lingulodinium machaerophorum</i>
		<i>Operculodinium centrocarpum s.s.</i>
		<i>Impagidinium paradoxum</i>
		<i>Brigantedinium spp.</i>
		<i>Artemisiocysta sp. 1</i>
		<i>Lejeuneocysta convexa</i>
		<i>Selenopemphix dionaeacysta</i>
		<i>Lejeuneocysta sp. 3</i>
		<i>Selenopemphix brevispinosa brevispinosa</i>
		<i>Trinovantedinium ferugnomatum</i>
		<i>Trinovantedinium glorianum</i>
		<i>Lejeuneocysta mariaeae</i>
		<i>Barssidinium evangeliae</i>
		<i>Hystrichosphaeropsis obscura</i>
		<i>Achomosphaera andalousiensis</i>
		<i>Nematosphaeropsis lemniscata</i>
		<i>Melitasphaeridium choanophorum</i>
		<i>Reticulatosphaera actinocoronata</i>
		<i>Invertocysta lacrymosa</i>
		<i>Labyrinthodinium truncatum truncatum</i>
		<i>Palaeocystodinium golzowense</i>
		<i>Batiacasphaera sphaerica</i>
		<i>Filisphaera filifera</i>
		<i>Xandarodinium xanthum sensu Head et al. 1989a</i>
		<i>Leipokatium invisitatum</i>
		<i>Quinquecuspis concreta</i>
		<i>Quadrina? condita</i>
		<i>Nematosphaeropsis rigida</i>
		<i>Tuberculodinium vancampoae</i>
		<i>Tectatodinium pellitum</i>
		<i>Spiniferites elongatus</i>
		<i>Bitectatodinium tepikiense</i>
		<i>Brigantedinium simplex</i>
		<i>Spiniferites mirabilis</i>
		<i>Spiniferites spp.</i>
		<i>Operculodinium centrocarpum sensu Wall & Dale 1968</i>
		<i>150-906A-4H-CC</i>
		<i>150-906A-5H-CC</i>
		<i>150-906A-TH-CC</i>
		<i>150-906A-9X-CC</i>
		<i>150-906A-11X-CC</i>
		<i>150-906A-13X-CC</i>
		<i>150-906A-15X-CC</i>
		<i>150-906A-19X-CC</i>
		<i>150-906A-21X-CC</i>
		<i>150-906A-23X-CC</i>
		<i>150-906A-25X-CC</i>
		<i>150-906A-29X-CC</i>
		<i>150-906A-31X-CC</i>
		<i>150-906A-33X-CC</i>
		<i>150-906A-35X-CC</i>
		<i>150-906A-37X-CC</i>
		<i>150-906A-41X-CC</i>
		<i>150-906A-43X-CC</i>
		<i>150-906A-47X-CC</i>
		<i>150-906A-49X-CC</i>
		<i>150-906A-51X-CC</i>
		<i>150-906A-53X-CC</i>
		<i>150-906A-57X-CC</i>

Notes: The depth (mbsf) for each sample is given in Shipboard Scientific Party (1994f, table 4). Solid dots indicate in situ occurrences; the symbol "R" indicates occurrences that are considered to have resulted from reworking. Taxon names followed by an asterisk (*) are from de Verteuil and Norris (in press, b, c); published taxon names followed by a question mark (?) indicate that assignment to the taxon is tentative.

112 species encountered in 28 samples

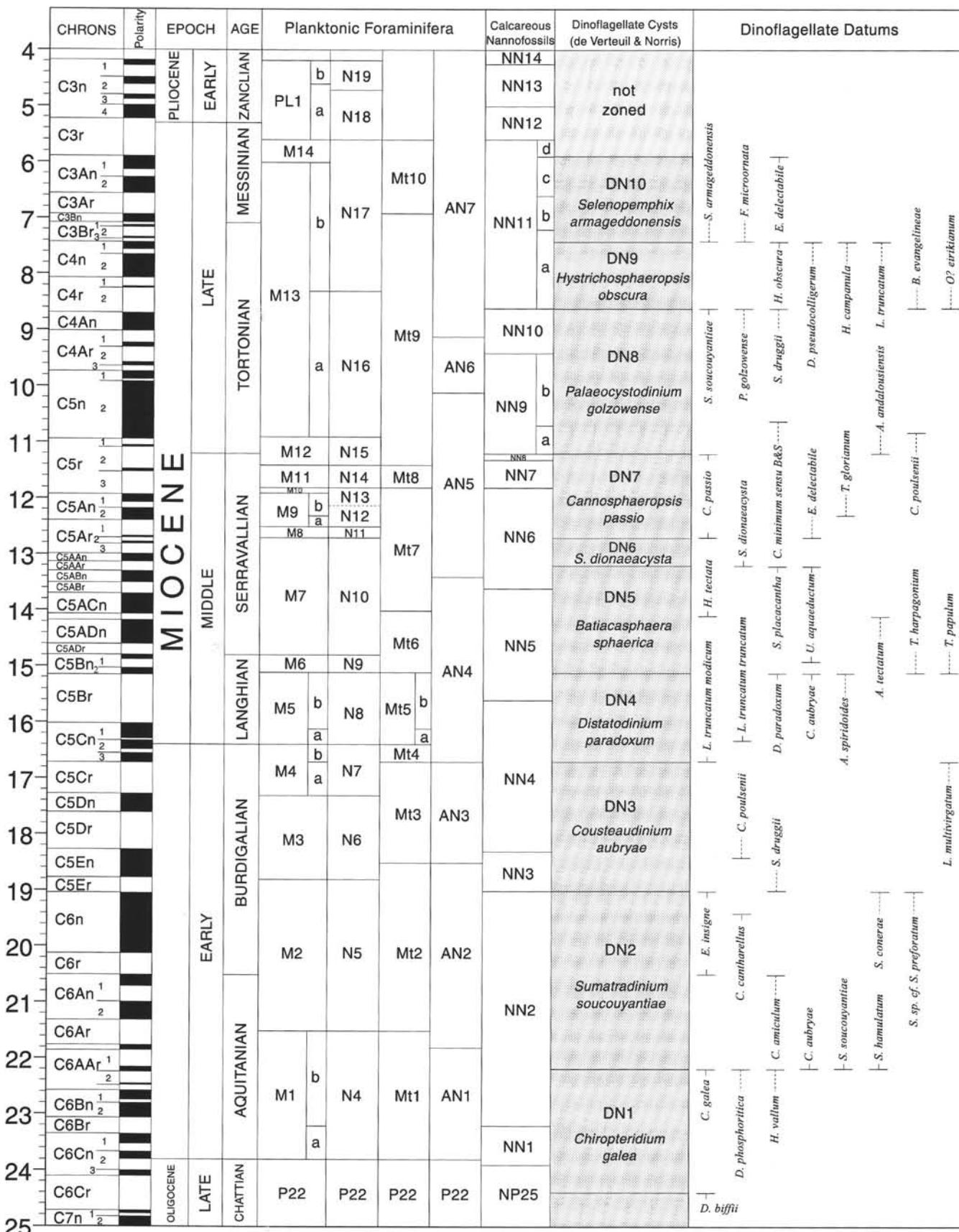


Figure 2. Summary of the temporal duration of DN Zones 1 through 10, together with dinocyst datums for the western North Atlantic, calibrated to the time-scale of Berggren et al. (1995). Dashed lines indicate uncertainty in some datum calibrations.